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Research Data on the Distribution and Abundance of Shrimp (*Pandalus borealis*) in the Cartwright Channel and Division 3K

by

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Abstract

Virtually no fishing effort was expended in either Cartwright Channel or Div. 3K in 1985.

The biomass estimate for Cartwright Channel in 1985 (2574 t) was less than the 1984 estimate. Shrimp were concentrated in the deepest part of the Channel in depths >450 m. Water temperatures were the lowest recorded since shrimp surveys were initiated in this area and sampling data indicated a potential decrease in productivity.

Research in Div. 3K was carried out both inside and outside the previously stratified area. The number of sets outside the area was limited due to rough bottom and shrimp were scarce in areas where fishing was possible. The biomass estimate inside the stratified area was higher in 1985 than in the previous year with improved precision due to an increase in the number of sets. However, estimates appear highly variable between years and shrimp in areas of highest abundance are generally small. Advice on TAC was provided for both areas.

Résumé

Il n'y a eu pratiquement aucun effort de pêche dans le Cartwright Channel ou la division 3K en 1985.

Les estimations de biomasse pour le Cartwright Channel en 1985 (2 574 t) ont diminué par rapport à 1984. Les crevettes étaient regroupées dans la partie la plus profonde du chenal, soit à plus de 450 m de profondeur. On a enregistré les températures d'eau les plus basses depuis qu'on effectue des études des crevettes dans ce secteur, et les données d'échantillonnage indiquent une diminution possible de la productivité.

Les travaux de recherche dans la division 3K ont été effectués à la fois à l'intérieur et à l'extérieur du secteur déjà stratifié. Le nombre de traits effectués à l'extérieur du secteur a été restreint à cause du fond accidenté, et les prises de crevettes ont été plutôt faibles aux endroits où la pêche a été possible. Les estimations de biomasse dans le secteur stratifié sont supérieures en 1985 par rapport à l'année précédente et bien plus exactes du fait qu'on a pu effectuer un plus grand nombre de traits de chalut. Cependant, les estimations semblent varier considérablement d'une année à l'autre et les crevettes pêchées dans les secteurs les plus abondants sont généralement petites. On donne des conseils sur l'établissement du TPA pour chacun des secteurs.

Introduction

There was no fishery for shrimp in either the Cartwright Channel or Division 3K in 1985. A research cruise was conducted in these areas, however, and a stratified random survey was completed in each. Also, other areas within Division 3K were fished to determine whether or not shrimp concentrations exist outside the St. Anthony Channel. Data from the 1985 survey are compared to those of previous years to evaluate stock status in both areas.

Cartwright Channel

Biomass

The 1985 survey in the Cartwright Channel was not affected by ice and a total of 46 successful sets was made in the area. Although the expanded stratified area was surveyed, most of the biomass was located in the old stratified zone in deep (>450 m) water (Table 1). The largest catch was 1600 kg in a 30 min tow on the northwestern side of the Channel in 500-550 m. Biomass was estimated at 2574 (±949) t, a decrease of 17% from the 1984 estimate (3113 t) but still higher than levels observed from 1981 to 1983 (Table 2, Fig. 1). Almost 2000 t of the 1985 estimate (80%) came from the old stratified area (700 strata), compared to 600 t (20%) over the Saddle. This is a complete reversal of the pattern of distribution observed in 1984 (Parsons and Veitch 1985a).

Size Composition

Length frequencies from the research survey in the Cartwright Channel in 1985 show the trend of increasing mean size with depth (Fig. 2). A broad range of sizes was observed at all depths but male shrimp, ranging from 15-20 mm carapace length, were dominant in depths less than 450 m. In the deeper (>450 m) strata, where shrimp were most abundant, females were proportionately higher but the male sizes were still well-represented in the catches. A high proportion of females was ovigerous and the proportion of ovigerous females increased with depth. Within the male sizes (≤20 mm), modal size (age) groups were severely overlapped but there is evidence of normal components at 15-16, 17-18 and 19-20 mm.

In 1984, males were dominant in shallower water (300-450 m) where abundance was high (Parsons and Veitch 1985a). The male component contributed significantly to the stock as well in 1985, but appeared substantially less than in the previous year. The pattern observed in 1985 is somewhat consistent with that expected in that part of the 1984 male component changed sex and migrated to deeper water while younger age groups grew and also moved deeper with the channel. It appears, however, that mortality was high within the male component and that males in 1985 were less abundant than in 1984.

Abundance of Predators

The estimate of biomass for Greenland halibut of 5500 t is the highest observed since the survey area was expanded in 1983 (Table 3). Most of the 1985 biomass was located in the old stratified area, unlike the previous year when over 40% was estimated to be over the Saddle. The pattern of distribution in both years followed closely the changes in distribution of shrimp.

Mean biomass of cod was estimated at 1266 t, much higher than in the previous two years. However, the estimate is too imprecise (±1127 t) for a meaningful breakdown between areas. Generally, cod were most abundant in the shallower strata (< 400 m) both in the Channel and over the Saddle where shrimp were very scarce.

The impact of predators in the Cartwright Channel is still a concern since there is evidence of increasing abundance of Greenland halibut and a return to the deeper parts of the channel where shrimp were most heavily concentrated. Although cod biomass increased over recent years, the predatory impact could be minimal due to the redistribution of shrimp to the deeper strata where cod abundance was low.

Discussion

In September 1985, the TAC for the Cartwright Channel was revised upwards from 770 t to 1000 t based on the average of the 1984 and 1985 biomass estimates to which the 35% exploitation rate was applied. Given that mid-season advice can only result in maintaining or raising the TAC (not decreasing), the following should be considered. Biomass in 1985 was estimated to be about 17% lower than in 1984 and males appeared to be less abundant. If mortality from 1985 to 1986 is high, as indicated for 1984/85, biomass in 1986 could be lower again but it is not possible to project by how much. Also, Greenland halibut were abundant in 1985 and the potential for predation was high which could contribute to decreased abundance in 1986. Finally, temperatures in 1985 were the coldest observed over the time series (<1.5°C). Productivity under these adverse environmental conditions will be suppressed and further instability in the stock can be expected.

It is difficult to say, at present, whether or not the fleet will fish in Cartwright Channel in 1986. This will depend on the relative success or failure of the Davis Strait and Hopedale Channel fisheries and the reactivation and/or redistribution of licences. Effort will be low unless catch rates in the area are significantly higher than in other areas. If biomass in 1986 is lower than that estimated for 1985, catch rates may not be high enough to attract the fleet and in this way the fishery self-regulates when abundance is low.

Given the above conditions and uncertainties, it would seem most appropriate to maintain the 1986 TAC at the revised 1985 level, 1000 t. If the stock size in 1986 is low, the TAC will not likely be taken and advice for a reduction in TAC can be considered for 1987.

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Division 3K

Distribution

Details of the 49 successful fishing sets (standardized 30-min tows) are given in Figure 3 and Table 4. Set numbers 133 to 151, inclusive, were made outside the stratified zone to determine if other areas of concentration exist in this Division. Fishable grounds were limited due to rough bottom in depths where shrimp usually are found (>300 m). In areas where a few sets could be made, shrimp were scarce, most sets yielding less than 50 kg per 30-min tow. One set produced a shrimp catch of approximately 150 kg but this was located just to the east of the previously stratified area.

Thirty random sets were made inside the stratified area (No. 152-181) with best catches occurring between 350 and 450 m. The highest catch was 225 kg in 381 m. As in the previous year (Parsons and Veitch 1985b), results were highly variable; catches ranged from 8 to 225 kg in 350-400 m and from 8 to 135 kg in 400-450 m. Catches in depths greater than 450 m were less variable but low (<40 kg).

Abundance

The estimate of biomass obtained from the 30 fishing stations made within the St. Anthony Channel was 4150 (±2265) t, most of which was located in the 350 to 400 m stratum (Table 5). This contrasts the estimate of 2840 t obtained in 1984 (Parsons and Veitch 1985b), 2354 t (83%) of which were estimated for the 400-450 m stratum. Despite the within stratum variability in catches, the confidence limits around the 1985 estimate are relatively good compared to those for other Labrador stocks. The 'precision' was improved to some extent by the increased sample size in the 1985 survey.

Size Distribution

Length frequencies by 50 m depth zone (Fig. 4) show increasing proportions of female (larger) shrimp with depth. Smaller male shrimp were more abundant in the 350-400 m stratum where most biomass was found. At intermediate depths, males and females were approximately equal in proportion and in the deeper water females dominated.

Compared to 1984 (Parsons and Veitch 1985b), more larger male shrimp were present in the 350-400 m stratum in 1985. A size (age) group around 14 mm dominated in these depths in 1984 but in 1985 there was a lack of shrimp less than 15 mm carapace length. Sizes and relative proportions were similar between the two years at intermediate depths but, again, the smallest size group of males (~14 mm) was absent in 1985. The deeper water was dominated by female shrimp in 1984 whereas in 1985, the proportion of males was substantially higher.

By-catches

Greenland halibut was the major by-catch species within the stratified area, similar to 1984 with catches ranging from 8 to 230 kg (Table 4). In other areas of Division 3K, Greenland halibut appeared less abundant except for several stations in the Funk Island Deep (sets 147-150). Cod, while abundant in 1984, were generally scarce throughout the Division in 1985. Best catches were less than 50 kg compared to several over 100 kg in the previous year and one greater than 450 kg. Redfish were scarce in the St. Anthony Channel but increased farther east (sets 138-143) with one catch greater than 1150 kg.

Discussion

Results of the 1985 survey in Division 3K indicate that outside the previously stratified area, shrimp catches were low or the grounds were too rough for trawling in depths suitable for shrimp. Shrimp were most abundant in the northern part of the Division in the St. Anthony Channel where concentrations were sufficiently dense for commercial activity. However, in the past two years, small shrimp were abundant in areas and depths where highest concentrations exist, making the area less attractive to industry given present market preference.

Recent biomass estimates indicate that shrimp abundance in this area also is highly variable between years. The 1985 estimate of 4150 t is much more precise than the 1984 estimate which was considered inappropriate for calculating a TAC based on a 35% exploitation rate. If the 1985 estimate is considered sufficiently precise, a TAC of 1450 t could be recommended for 1986. The usefulness of such advice, however, is limited by the apparent instability in abundance between years and the lack of a series of estimates which could be used to average out this variability. If fishing activity increases in this Division, it may be necessary to survey the area annually and make mid-season updates, similar to the approach used for the Hopedale and Cartwright Channels. In the meantime, however, it may be sufficient to maintain the present preemptive TAC of 500 t until some commercial interest is indicated.

References

Parsons, D. G. and P. J. Veitch. 1985a. An Analysis and Interpretation of the 1984 Data on Research and Commercial Fishing for Shrimp (Pandalus borealis) in the Cartwright and Hopedale Channels. CAFSAC Res. Doc. 85/17. 30 p.

1985b. Results of a Survey for Shrimp (Pandalus borealis) in Division 3K, July 1984. CAFSAC Res. Doc. 85/18. 16 p.

Table 1. Minimum trawlable biomass (t) - 1985 research - Cartwright Channel.

Stratum	Depth (m)	Area (sq n mi)	No. sets	Biomass (t)
704 + 705	<300	66.6	3	0
706	301-350	45.7	4	12
707	351-400	36.0	4	21
708	401-450	45.0	4	168
709	451-500	53.9	4	340
710	501-550	89.7	4	964
711	451-500	15.6	2	25
806	301-350	78.2	2	6
807	351-400	66.9	3	43
808	401-450	47.3	4	213
809	451-500	37.3	4	55
810	501-550	6.5	3	285
712 + 812	>551	44.3	4	442
Total		633.0	45	2574

Table 2. Biomass estimates (t) and 95% confidence intervals for shrimp, 1979-85, Cartwright Channel.

Year	Mean[a]	Upper	Lower	Area (sq n mi)	n
1979	1,892	2,879	904	286	22
1980	2,789	3,422	2,157	417	37
1981	2,367	3,380	1,355	503	49
1982	1,916	2,867	965	503	42
1983	1,111[b]	1,446	775	713	56
	694[c]	885	503	561	51
1984	3,113[b]	4,863	1,362	880	47
	579[c]	937	222	561	32
1985	2,574[b]	3,523	1,625	633	45
	1,972[c]	3,019	926	397	29

[a] 1978-81 estimates are derived from systematic line surveys
1982-85 estimates are derived from random-stratified surveys

[b] Expanded stratification

[c] Old stratification

Table 3. Biomass estimates (t) and 95% confidence intervals for Greenland halibut and cod, 1979-85, Cartwright Channel.

	Greenland halibut			Cod		
Year	Mean	Upper	Lower	Mean	Upper	Lower
1979	1,739	2,685	793	244	426	62
1980	5,332	6,189	4,476	331	502	160
1981	1,376	2,042	710	751	1,403	99
1982	3,061	3,934	2,188	1,017	1,414	620
1983[a]	4,586	5,512	3,661	513	755	271
1983[b]	3,538	4,420	2,656	413	634	193
1984[a]	2,900	5,296	503	602	951	253
1984[b]	1,691	2,359	1,023	175	861	-510
1985[a]	5,512	7,595	3,430	1,266	2,393	139
1985[b]	5,052	7,127	2,977	608	1,782	-567

[a] Expanded stratification

[b] Old stratification

Table 4. Details of research fishing stations in Div. 3K, 1985.

Set no.	Lat.	Long.	Date	Time	Dur.	Depth (m)	Catch (kg)				
							Shrimp	Cod	Turbot	Plaice	Redfish
133	5150.8	5238.8	8/15	0420	30	315	7.7	6.8	15.0	6.4	1.8
134	5154.7	5157.6	8/15	0910	30	388	39.5	5.4	0.9	4.1	4.1
135	5137.8	5237.0	8/15	1305	30	408	152.9	-	19.5	0.5	4.5
136	5129.1	5237.6	8/15	1459	30	487	30.2	1.4	123.4	7.7	3.1
137	5128.7	5241.6	8/15	1655	30	424	19.4	1.4	51.3	1.4	25.4
138	5114.3	5214.0	8/15	2114	30	381	28.0	47.2	10.9	5.9	114.2
139	5040.9	5115.7	8/16	0240	30	312	2.9	1.6	0.5	-	45.8
140	5042.0	5054.5	8/16	0524	30	353	11.3	0.1	1.1	-	72.1
141	5023.6	5041.3	8/16	0926	30	508	-	-	25.0	-	204.5
142	5005.7	5037.0	8/16	1234	30	330	26.6	10.0	2.0	1.4	862.7
143	5009.0	5033.2	8/16	1452	30	440	-	-	9.1	-	1155.9
144	5029.8	5248.1	8/17	0040	30	320	22.1	10.4	8.6	4.1	-
145	5028.5	5252.0	8/17	0158	30	391	13.4	1.8	21.3	-	-
146	5031.6	5255.6	8/17	0354	30	430	6.1	0.2	73.0	-	3.6
147	5033.2	5303.1	8/17	0530	30	474	4.8	0.7	74.4	0.9	5.0
148	5033.8	5310.6	8/17	0700	30	468	6.9	-	73.5	0.8	3.9
149	5032.7	5315.7	8/17	0836	30	421	60.0	10.9	259.9	1.4	-
150	5033.2	5330.6	8/17	1059	35	390	42.6	4.5	161.0	0.2	0.5
151	5036.6	5336.0	8/17	1229	30	314	2.7	0.5	5.4	-	-
152	5125.9	5340.5	8/17	1813	30	405	16.0	3.0	73.5	2.0	-
153	5134.3	5347.9	8/17	2010	30	395	8.8	10.9	133.4	0.9	0.2
154	5137.4	5341.0	8/17	2138	30	425	32.2	12.3	39.0	2.3	5.0
155	5136.6	5333.5	8/17	2307	30	451	10.6	8.2	90.7	0.5	2.3
156	5138.4	5348.5	8/18	0135	30	382	8.1	0.6	73.5	0.9	0.5
157	5142.0	5348.0	8/18	0315	25	347	44.5	0.7	29.9	1.4	6.4
158	5141.4	5339.7	8/18	0448	30	445	45.1	14.5	164.2	2.3	4.1
159	5140.3	5332.8	8/18	0635	30	465	15.9	0.5	102.1	-	0.2
160	5144.4	5335.7	8/18	0819	30	466	27.8	-	137.4	1.1	1.8
161	5147.4	5340.1	8/18	1000	30	440	134.3	6.8	78.5	0.1	3.0
162	5148.1	5335.6	8/18	1141	30	460	25.8	1.4	78.5	1.4	3.2
163	5153.4	5336.5	8/18	1314	30	438	51.3	4.1	183.7	0.9	1.4
164	5156.0	5341.1	8/18	1432	30	433	61.2	3.6	131.1	0.9	5.4
165	5156.7	5348.8	8/18	1608	35	381	225.0	44.6	229.5	1.8	1.4
166	5203.0	5331.5	8/18	1838	30	405	134.7	17.7	99.8	4.1	2.3
167	5206.4	5340.8	8/18	2020	30	445	36.4	15.0	117.9	0.5	0.9
168	5218.5	5344.4	8/18	2219	30	412	13.8	0.6	92.5	0.3	0.5
169	5216.5	5323.9	8/19	0041	30	376	10.1	4.1	44.0	-	3.2
170	5215.6	5320.5	8/19	0218	30	367	13.9	9.1	34.9	0.9	3.9
171	5208.2	5325.7	8/19	0459	30	383	134.5	27.7	29.9	5.9	1.6
172	5145.5	5328.8	8/19	0823	30	462	34.5	4.1	57.2	0.7	1.4
173	5149.5	5326.4	8/19	1032	30	445	20.4	3.2	52.2	0.2	1.4
174	5142.0	5323.0	8/19	1229	30	465	23.1	4.5	66.2	5.4	1.8
175	5148.9	5317.4	8/19	1426	26	409	26.7	-	35.4	0.5	3.6
176	5151.1	5307.8	8/19	1634	30	376	101.2	13.6	7.7	0.5	9.5
177	5142.7	5307.2	8/19	1850	30	424	54.4	13.2	29.0	6.8	5.0
178	5141.8	5310.5	8/19	2050	30	470	39.2	6.8	102.1	1.1	2.7
179	5136.6	5315.8	8/19	2248	30	434	8.1	1.8	39.0	-	2.3
180	5135.1	5321.8	8/20	0040	30	429	52.2	20.9	200.9	0.7	2.3
181	5138.9	5321.5	8/20	0228	30	450	19.4	0.5	104.3	2.7	1.8

Table 5. Estimate of shrimp biomass (t), Div. 3K, 1985.

Stratum	Depth (m)	Area (sq n mi)	No. sets	Total catch (kg)	Av. per set	Var.	Total (t)	95% C.I. Upper	95% C.I. Lower
107	350-400	676	8	515	64.4	4766	2444.2		
108	400-450	579	15	710	47.4	1519	1539.4		
109	>450	117	7	177	25.3	99	166.0		
Total		1372	30	1402			4149.6	6415.4	1883.8

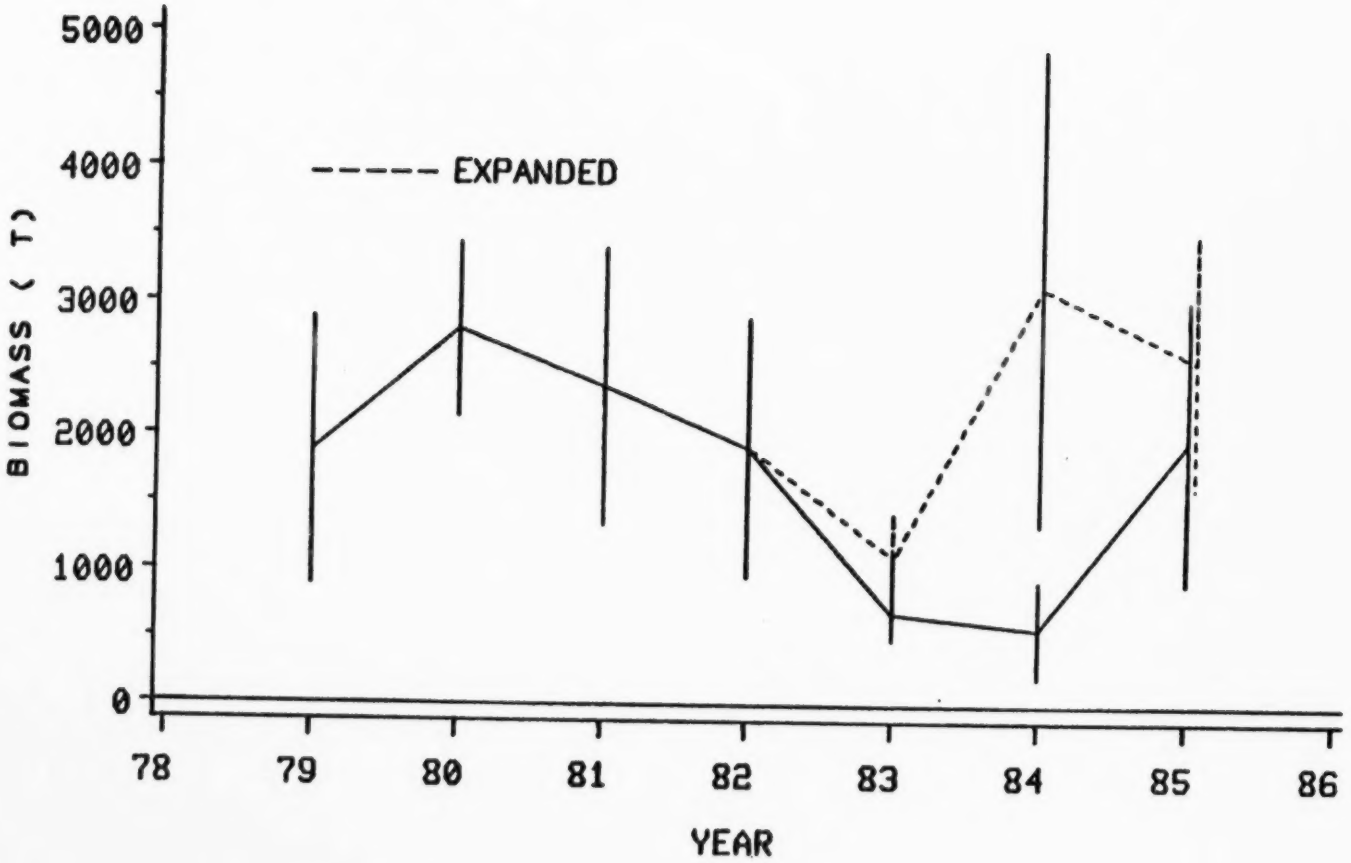

Fig.1. Estimates of mean biomass and 95% confidence intervals for shrimp in Cartwright Channel, 1979-1985. (Broken line represents the expanded straitified area, 1983-1985.)

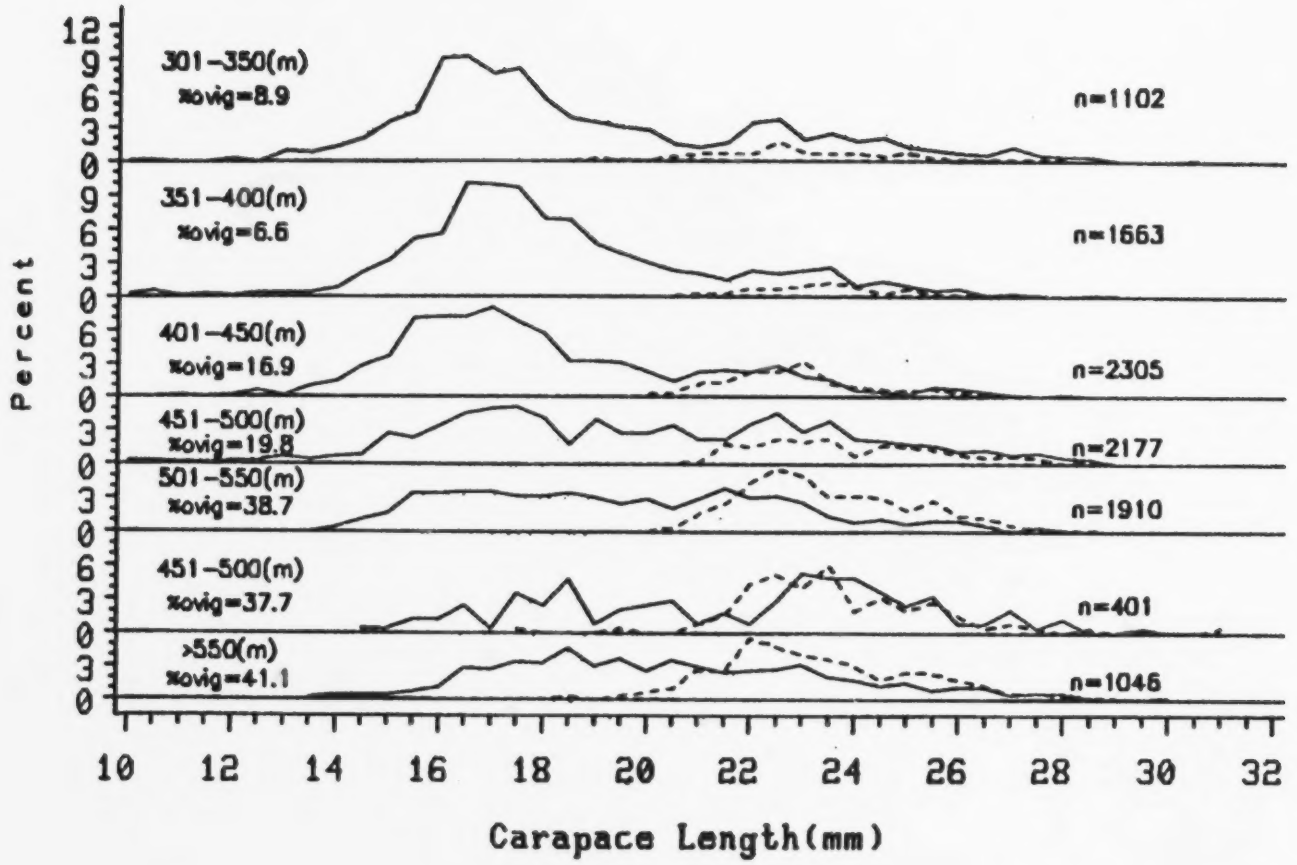

Fig.2. Size distribution of shrimp in the Cartwright Channel from the August,1985 research survey.(Broken line represents ovigerous females.)

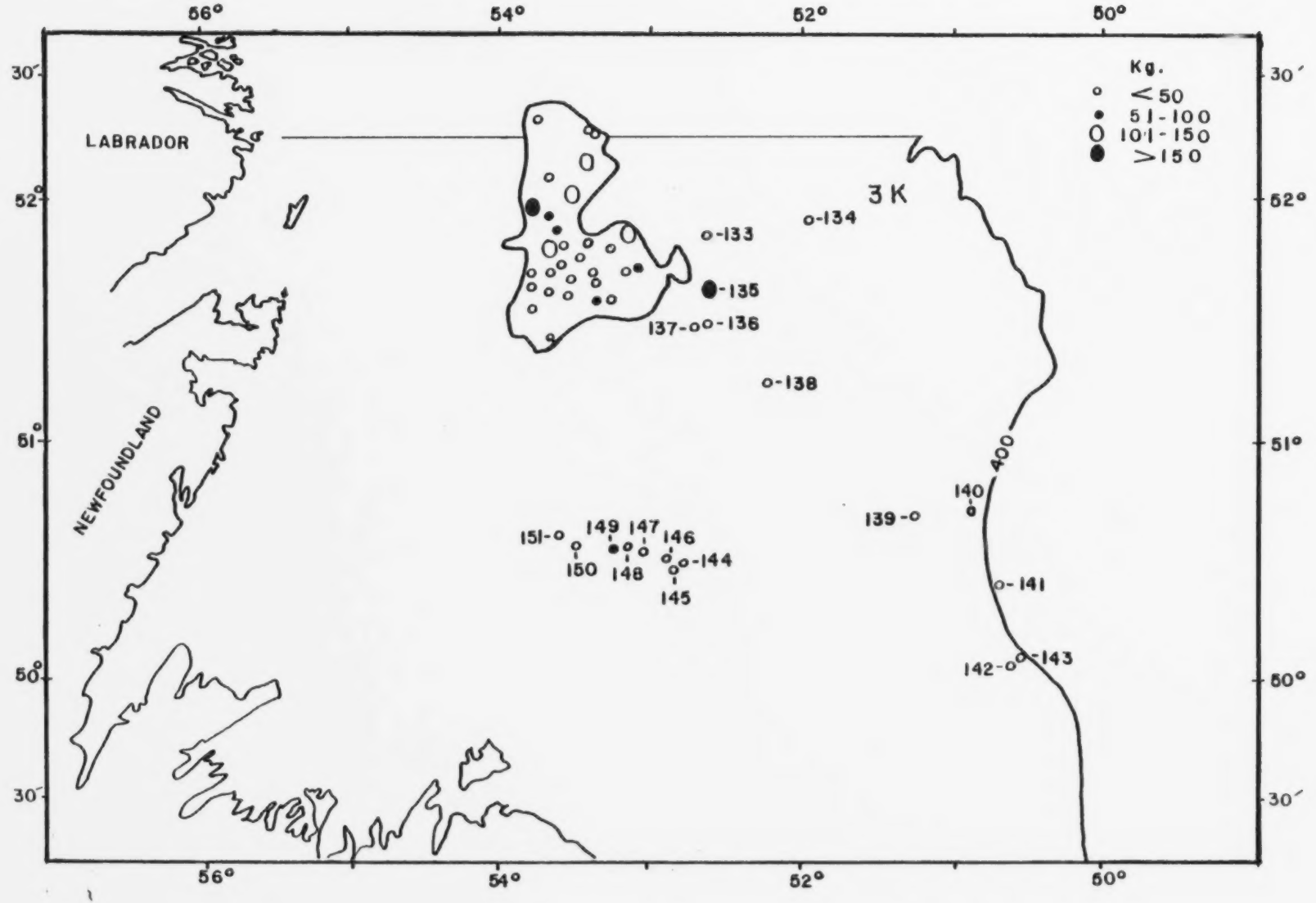

Fig.3. Fishing stations and shrimp catches in Division 3K,1985 - research.

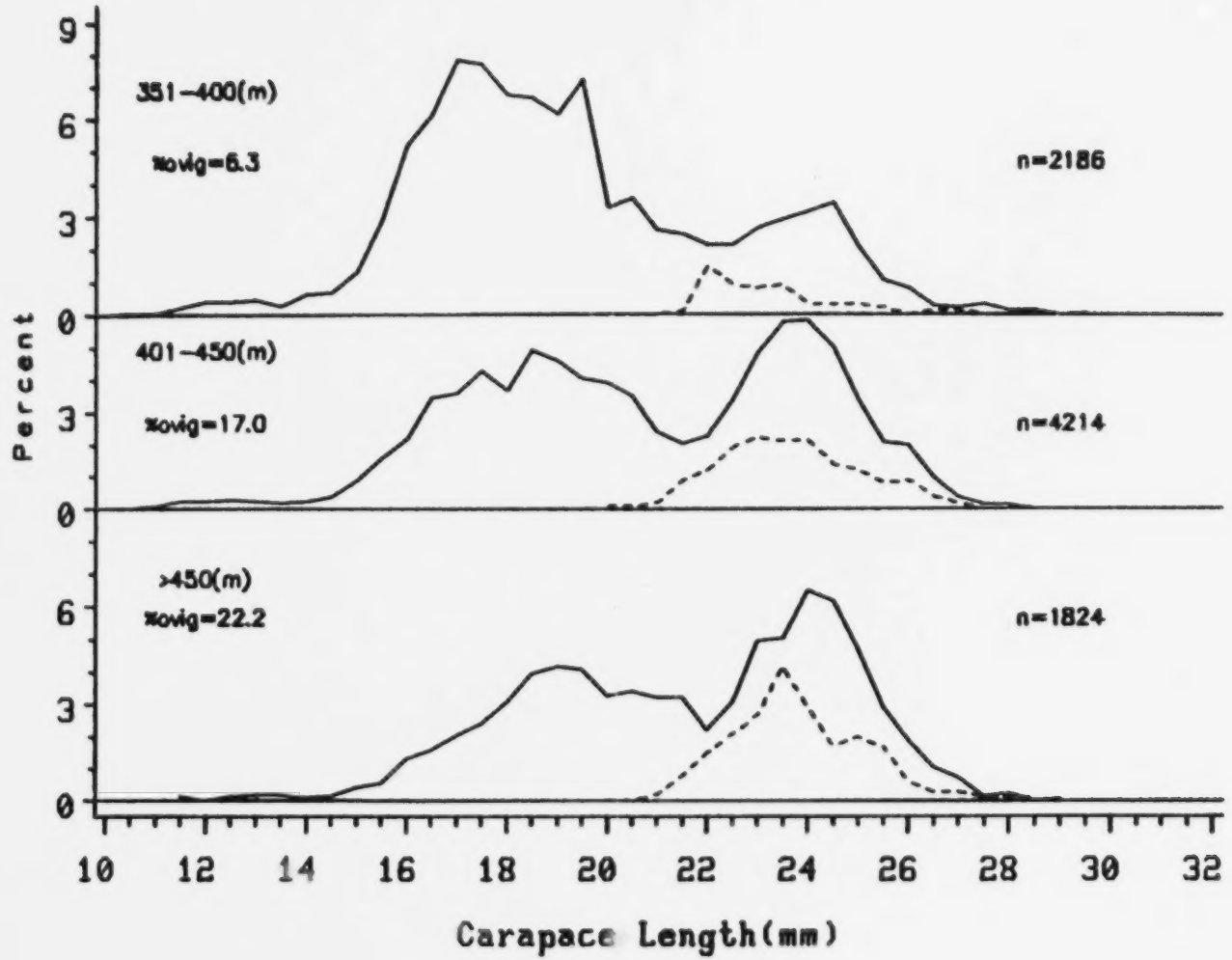

Fig.4. Size distributions of shrimp in the St. Anthony Channel from the August,1985 research survey.(broken line represents ovigerous females.)

Appendix 1. Details of research sampling for shrimp in Cartwright Channel,1985.

Sex	Maturity	No.	% of Total
Juvenile	Immature	0	0.00
Male	Immature	0	0.00
Male	Maturing (small vas deferens)	28	4.72
Male	Mature (large vas deferens)	261	44.01
Transitional	Small ovary	1	0.17
Transitional	Large ovary	22	3.71
Female (non-ovigerous)	Sternal spines, small ovary	0	0.00
Female (non-ovigerous)	Sternal spines, large ovary	0	0.00
Female (non-ovigerous)	No spines, small ovary	99	16.69
Female (non-ovigerous)	No spines, large ovary	5	0.84
Female	Ovigerous	177	29.85
Totals		593	100.00